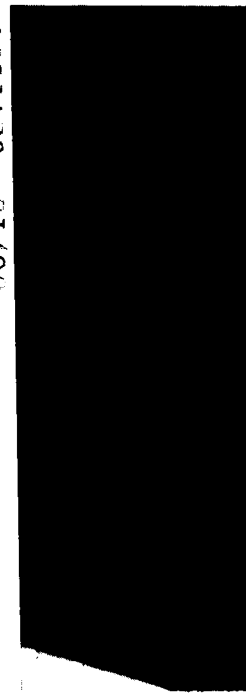
GSFC

ADVANCED TIROS-N (ATN)

NOAA-G

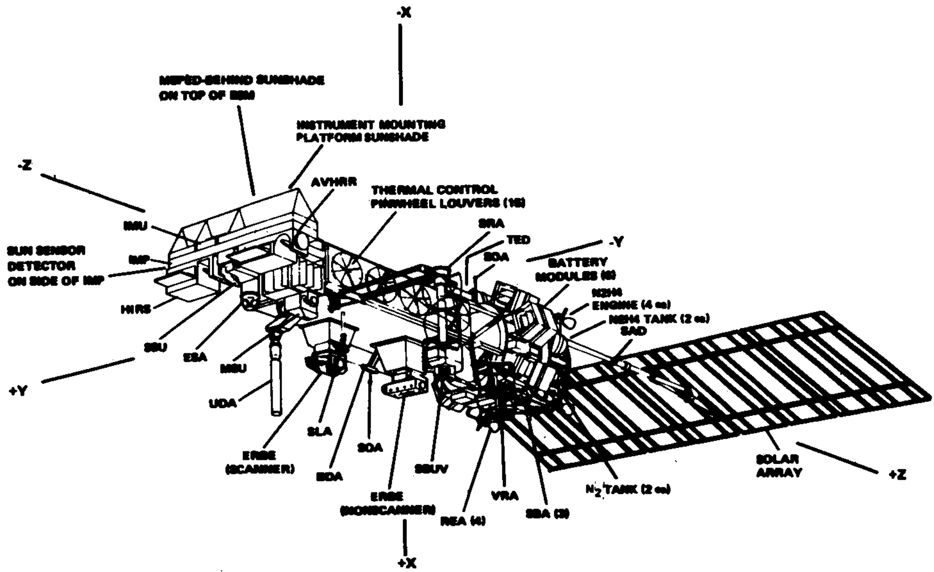


NASA
National Aeronautics and
Space Administration

Goddard Space Flight Center
Greenbelt, Maryland

NOAA
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
U.S. DEPARTMENT OF COMMERCE

**National Environmental
Satellite, Data, and
Information Service
Suitland, Maryland**



LEGEND	
AVHRR	ADVANCED VERY HIGH RESOLUTION RADIOMETER
BDA	BEACON/COMMAND ANTENNA
*ERBE-NS	EARTH RADIATION BUDGET EXPERIMENT- -NONSCANNER
*ERBE-S	EARTH RADIATION BUDGET EXPERIMENT- -SCANNER
ESA	EARTH SENSOR ASSEMBLY
HIRS	HIGH-RESOLUTION INFRARED SOUNDER
IMP	INSTRUMENT MOUNTING PLATFORM
IMU	INERTIAL MEASUREMENT UNIT
MEPED	MEDIUM ENERGY PROTON AND ELECTRON DETECTOR
MSU	MICROWAVE SOUNDING UNIT
REA	REACTION ENGINE ASSEMBLY
SAD	SOLAR–ARRAY DRIVE
SBA	S–BAND ANTENNA
*SBUV	SOLAR BACKSCATTER ULTRAVIOLET SOUNDING SPECTRAL RADIOMETER
SLA	SEARCH–AND–RESCUE TRANSMITTING ANTENNA (L–BAND)
SOA	S–BAND OMNI ANTENNA
SRA	SEARCH–AND–RESCUE RECEIVING ANTENNA
SSD	SUN SENSOR DETECTOR
*SSU	STRATOSPHERIC SOUND UNIT
TED	TOTAL ENERGY DETECTOR
UDA	ULTRA–HIGH–FREQUENCY DATA COLLECTION SYSTEM ANTENNA
VRA	VERY–HIGH–FREQUENCY REALTIME ANTENNA

*The ERBE-NS and S and SBUV/2 were dummies on the NOAA-E. Operational Instruments flew on NOAA-F. NOAA-G will fly a dummy SBUV/2 and a dummy SSU. Operational ERBE-NS and S will fly on NOAA-G.

NOAA-G Spacecraft with Major Features Identified

TIROS PROGRAM

INTRODUCTION

The Advanced TIROS-N (ATN) program is an extension of the TIROS program. The ATN adds additional instruments that are described later in this document. The program is a cooperative effort of the National Aeronautics and Space Administration (NASA), the National Oceanic and Atmospheric Administration (NOAA), the United Kingdom, and France for providing day and night global environmental and associated data for operational purposes on a regular daily basis. Elements of the Search and Rescue (SAR) system are provided by Canada and France. The U.S. Air Force provides launch support, and General Dynamics Convair (GDC) provides the Atlas launch vehicle.

TIROS-N was launched October 13, 1978, at 11:23 Z into a 470-nmi orbit. It was the first in the series of a third-generation operational environmental satellite system. TIROS-N was a research and development spacecraft serving as a protoflight for the operational follow-on series, NOAA-A through -G spacecraft.* Advanced instruments measure parameters of the Earth's atmosphere, its surface and cloud cover, the solar protons, the positive ions, the electron-flux density, and the energy spectrum at the satellite altitude. As a part of its mission, the spacecraft also receives, processes, and retransmits data from free-floating balloons, buoys, and remote automatic observation stations distributed around the globe. The spacecraft was designed to permit future growth as demonstrated by the SAR experiment being flown on NOAA-E, -F, and -G. The Astro Electronics Division of RCA is the prime contractor for the spacecraft. The operational system consists of two satellites in Sun-synchronous orbits—one in a morning orbit at 450 nmi and one in an afternoon orbit at 470 nmi.

NOAA-A (-6) was launched June 27, 1979, at 15:51:59 Z and is performing satisfactorily. The satellite, which was launched into a 450-nmi orbit, has greatly exceeded its 2-year lifetime. The satellite remains operational with the HIRS failed, TIP parity errors through the MIRP, and a degraded power system.

NOAA-B was launched May 29, 1980, at 10:53 Z and failed to achieve a usable orbit because of a booster engine malfunction.

NOAA-C (-7) was launched June 23, 1981, at 10:52:59 Z into a 470-nmi orbit and is performing satisfactorily. The satellite is in standby with the HIRS failed, degraded SSU, and a severely degraded power system.

NOAA-E (-8) was launched March 28, 1983, at 15:51:59.953 Z into a 450-nmi orbit. The RXO failed after 14 months in orbit. The RXO recovered from its failure, locking

*Redesignated NOAA-6 through -11 after launch – Note: NOAA-B did not receive a number as it did not achieve orbit due to a launch-vehicle failure. Therefore, NOAA-C became NOAA-7 in orbit. NOAA-D is in a storage configuration waiting disposition by NOAA.

up on the RXO back-up side in May 1985. The spacecraft was stabilized and declared operational by NOAA July 1, 1985. There is an anomaly in one of the HIRS detectors incapacitating 12 of its 20 channels. Also, one of the 16 ESA detectors has failed but this does not affect performance.

NOAA-F (-9) was launched December 12, 1984, at 10:41:59.8 Z into a 470-nmi orbit and is performing satisfactorily.

NOAA-G will be in a 450-nmi morning orbit and will transmit data directly to users around the world for local weather analysis. The operational ground facilities include the Command and Data Acquisition (CDA) stations in Alaska and Virginia, the Satellite Operations Control Center (SOCC) and Data Processing Services Subsystem (DPSS) facilities in Suitland, Maryland, and a data receiving location in Lannion, France. To continue initial support for Search and Rescue using the 121.5/243-MHz system and to begin the process for making the system operational for the 406-MHz system, NOAA-G will carry special instrumentation for evaluating a satellite-aided SAR system that may lead to the establishment of a fully operational capability. The SAR system was initiated on NOAA-E (-8).

The objectives of the SAR mission are to:

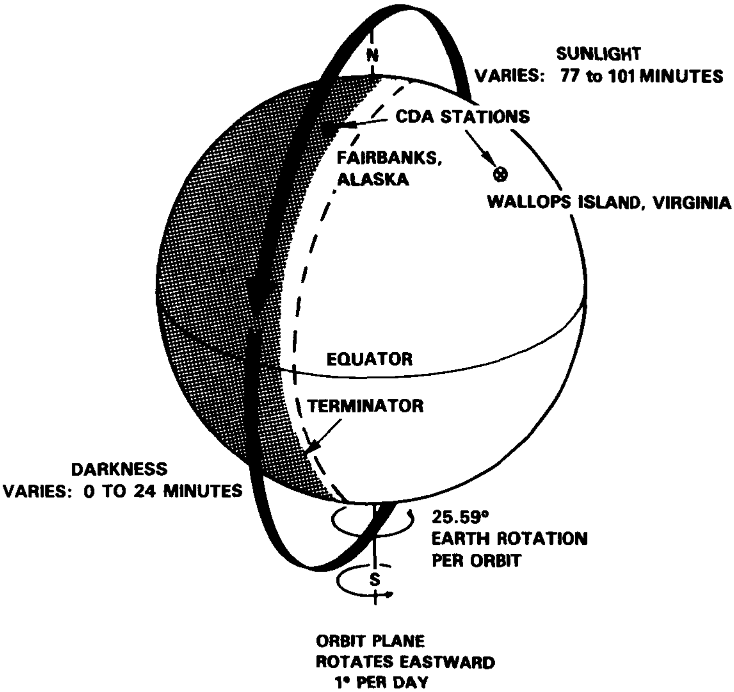
- Continue the initial operational use of a spaceborne system to acquire, track, and locate the existing Emergency Locator Transmitters (ELT's) and Emergency Position Indicating Radio Beacons (EPIRB's) that are currently in the field (approximately 150,000 units) operating on 121.5 and 243 MHz

- Demonstrate and provide for operational use of the improved capability for detecting and locating distress incidents utilizing new ELT/EPIRB's operating on 406 MHz. This new capability will provide higher probability of detection and location, greater location accuracy, and coded user information and allow for the necessary growth of an increased population of users. In addition, this capability will allow for global coverage by providing spaceborne processing and storage of the 406-MHz data.

PHYSICAL CHARACTERISTICS

The physical characteristics of the NOAA-G Spacecraft are:

- Main body: 4.18 meters (13.7 feet) long, 1.88 meters (6.2 feet) in diameter
- Solar array: 2.37 by 4.91 meters (7.8 by 16.1 feet), 11.6 meters^2 (125 feet^2)
- Weight: At liftoff, 1712 kg (3775 lb); on orbit, 1030 kg (2288 lb)
- Power: Orbit average end of life–551 watts for gamma angle = 0°, 515 watts for gamma angle = 68°
- Lifetime: Greater than 2 years



ORBITAL CHARACTERISTICS
Apogee — 833 - km (450 nmi)
Perigee — 833 - km (450 nmi)
Minutes per orbit — 101.35
Degrees inclination — 98.7

NOAA-G Orbit

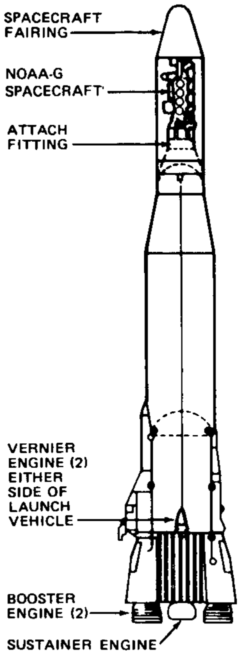
ORBIT

NOAA-G is a three-axis-stabilized spacecraft that will be launched into an 853-km (450-nautical mile) circular, near-polar orbit with an inclination angle of 98.7 degrees (retrograde) to the Equator. Total orbital period will be approximately 101.35 minutes. The sunlight period will vary from 75 to 100 percent of the orbital period, depending on time of year. Because the Earth rotates beneath the orbit 25.59 degrees during each orbit, the satellite observes a different portion of the Earth's surface each orbit.

The nominal orbit is planned to be Sun-synchronous and precesses (rotates) eastward about the Earth's polar axis 0.986 degree per day—the same rate and direction as the Earth's average daily rotation about the Sun. This precession keeps the satellite in a constant position with reference to the Sun for consistent illumination throughout the year. NOAA-G will be launched so that it will always cross the Equator at about 7:30 a.m. southbound and 7:30 p.m. northbound local solar time.

The circular orbit permits uniform data acquisition by the satellite and efficient command control of the satellite by the CDA stations located near Fairbanks, Alaska and Wallops Island, Virginia.

LAUNCH VEHICLE



Atlas-E Launch Vehicle

The spacecraft will be launched from the Air Force Western Space and Missile Center at Vandenberg Air Force Base, California, by an Atlas-E launch vehicle. The standard Atlas launch vehicle consists of an E-series Atlas ballistic missile that has been refurbished and modified to a standard configuration for use as a launch vehicle for orbital missions. It is capable of launching a spacecraft into a variety of low Earth orbits. The launch vehicle is manufactured by GDC.

The vehicle stands 28.7 meters (94 feet) tall and is 3.05 meters (10 feet) in diameter. The fairing is 7.42 meters (24.3 feet) long and is 2.13 meters (7 feet) in diameter. At liftoff, it carries 69 kiloliters (18,294 gallons) of liquid oxygen and 43 kiloliters (11,384 gallons) of RP-1 fuel, a highly refined kerosene. Engine data are as follows:

	Booster	Sustainer	Vernier
No. of Engines	2	1	2
Thrust per engine (lb)	165,000	57,000	1,000
Thrust per engine (N)	633,920	253,536	4,448
Thrust duration liftoff to	+120 sec	+320 sec	+340 sec

From liftoff to +60 seconds, airborne autopilot programmer in the launch-vehicle flight-control system provides steering and discrete commands. The General Electric Radio Tracking System (GERTS) ground station and guidance computer then perform the guidance function via the launch vehicle's pulse beacon system.

The vehicle is powered by one sustainer, two boosters, and two vernier engines using liquid oxygen, liquid hydrocarbon propellants. A 0.97-meter (38-inch) diameter attach fitting fastens the NOAA-G spacecraft to the launch vehicle. The fairing attached to the forward face of the launch vehicle protects the spacecraft from aerodynamic heating during the boost flight.

NOAA-G INSTRUMENTATION

The instrument systems provide both direct readout (real-time) and onboard recording (playback) of environmental data during day and night operation. The primary instruments carried by the NOAA-G spacecraft with the manufacturer in parentheses are:

- Advanced Very High Resolution Radiometer (ITT) (4 Channel)
- High Resolution Infrared Radiation Sounder (ITT)
- Search and Rescue
  - SAR Repeater (CRC/Canada)
  - SAR Processor (CNES/France)
- Microwave Sounding Unit (JPL)
- ERBE-Scan and Nonscan (TRW)
- Space Environment Monitor (FACC)
- ARGOS Data Collection System (CNES/France)

ADVANCED VERY HIGH-RESOLUTION RADIOMETER

The Advanced Very High-Resolution Radiometer (AVHRR), provided by ITT, is a radiation-detection instrument used to remotely determine the surface temperature. This scanning radiometer uses four detectors that collect different bands of radiation wavelengths as shown in Table 1. Measuring the same view, this array of diverse wavelengths, after processing, will permit multispectral analysis for more precisely defining hydrologic, oceanographic, and meteorological parameters. One channel will monitor energy in the visible band and another in the near-infrared portion of the electromagnetic spectrum to observe clouds, lakes, shorelines, snow, and ice. Comparison of data from these two channels can indicate the onset of ice and snow melting. Depending on which instrument is used, the other two or three channels operate entirely within the infrared band to detect the heat radiation from and, hence, the temperature of, the land, water, and sea surfaces and the clouds above them.

SPACE ENVIRONMENT MONITOR

The Space Environment Monitor (SEM), provided by Ford Aeronautics Communications Corporation (FACC), is a multichannel charged-particle spectrometer. It measures the population of the Earth's radiation belts and the particle precipitation phenomena resulting from solar activity (both of which contribute to the solar/terrestrial energy interchange). The SEM consists of two separate sensor units and a common Data Processing Unit (DPU). The sensor units are the Total-Energy Detector (TED) and the Medium-Energy Proton/Electron Detector (MEPED). Both the MEPED and the TED have pairs of sensors with different orientations because the direction of

Table 1
Advanced Very High-Resolution Radiometer*
(AVHRR)

Characteristics	Channels			
	1	2	3	4
Spectral range (micrometers)	0.58 to 0.68	0.725 to 1.0	3.55 to 3.93	10.5 to 11.5
Detector	Silicon	Silicon	InSb	(HgCd)Te
Resolution (km at nadir)	1.1	1.1	1.1	1.1
Instantaneous field of view (IFOV) (milliradians)	1.3 sq.	1.3 sq.	1.3 sq.	1.3 sq.
Signal-to-noise ratio at 0.5 albedo	>3:1	>3:1	–	–
Noise-equivalent temperature difference at (NEΔT) 300 K	–	–	<0.12 K	<0.12 K
Scan angle (degrees)	±55	±55	±55	±55
Optics – 8-inch diameter afocal Cassegrainian telescope Scanner – 360-rpm hysteresis synchronous motor with beryllium scan mirror Cooler – Two-stage radiant cooler, infrared detectors controlled at 105 or 107 K Data output – 10-bit binary, simultaneous sampling at 40-kHz rate				

the particle fluxes is important in characterizing the energy interchanges taking place. The objectives of the SEM are to determine the energy deposited by solar particles in the upper atmosphere and to provide a solar warning system.

Components

- Total-Energy Detector cylindrical electrostatic analyzer and spiraltron

- Medium-Energy Proton and Electron Detector solid-state detector telescopes and omnidetectors

Performance

- TED: Proton – 0.3 to 20 keV in 11 bands
  Electron – 0.3 to 20 keV in 11 bands

- MEPED: Proton – 30 to 2500 keV in 5 bands
  Electron – > 30 to > 300 kev in 3 bands
  Ions – > 6 MeV
  Omniproton – > 16 MeV, > 36 MeV, > 80 MeV

TIROS OPERATIONAL VERTICAL SOUNDER SYSTEM (TOVS)

The TOVS system consists of three instruments: the High-Resolution Infrared Radiation Sounder modification 2 (HIRS/2), the Stratospheric Sounding Unit (SSU), and the Microwave Sounding Unit (MSU). All three instruments measure radiant energy from the atmosphere, and the data are used to determine the atmosphere's temperature profile from the Earth's surface to the upper stratosphere. Pertinent information appears in the following sections.

HIGH-RESOLUTION INFRARED RADIATION SOUNDER (HIRS/2)

This instrument, provided by ITT, detects and measures energy emitted by the atmosphere to construct a vertical temperature profile from the Earth's surface to an altitude of about 40 kilometers. Measurements are made in 20 spectral regions in the infrared band. (One frequency lies at the high end of the visible range.) Table 2 summarizes the HIRS/2 instrument characteristics.

MICROWAVE SOUNDING UNIT (MSU)

This unit, provided by Jet Propulsion Laboratory, detects and measures the energy from the troposphere to construct a vertical temperature profile to an altitude of about 10 kilometers. Measurements are made by radiometric detection of microwave energy divided into four frequency channels as shown in Table 3. Each measurement is made by comparing the incoming signal from the troposphere with the ambient temperature reference load. Since its data are not seriously affected by clouds, it is used in conjunction with the HIRS/2 to remove measurement ambiguity when clouds are present.

Table 2
High-Resolution Infrared Radiation Sounder (HIRS/2)

Characteristics	Channels		
	1 – 12	13 – 19	20
Spectral range (micrometers)	6.72 – 14.95	3.76 – 4.57	0.69
Detector	(HgCd)Te	InSb	Silicon
Resolution (km at nadir)	20.4	20.4	20.4
IFOV (milliradians)	24	24	24
Noise equivalent radiance (NEΔN)	0.03 to 0.96	0.003 K 0.0002 to 0.001	–
Scan width from nadir (degrees)	±49.5	±49.5	±49.5

Optics – 5.9-inch diameter Cassegrainian telescope

Scanner – 1.8-degree stepper, 56 scan steps then retrace

Cooler – Two-stage radiant cooler, infrared detectors controlled at approximately 107 K

Data output – 13-bit binary, channels sampled sequentially at 2.88-kbps rate

SEARCH AND RESCUE (Provided by Canada and France)

The SAR instruments will provide the dual capability of detecting and locating existing ELT/EPIRB's operating at 121.5 and 243 MHz, as well as experimental ELT/EPIRB's operating at 406 MHz. The 121.5, 243, and 406 MHz will be received by the SAR instruments and broadcast in real time on an L-band frequency, which will be monitored by Local User Terminals (LUT's). Reports of ELT and EPIRB signals are via mission control centers to rescue coordination centers where rescue action can be initiated. The 406-MHz data, which will be processed, sent by real time, and stored on

Table 3
Microwave Sounding Unit

Characteristics	Channel			
	R_1	R_2	R_3	R_4
Frequency (GHz)	50.30	53.74	54.96	57.05
RF bandwidth (MHz)	220	220	220	220
Resolution (km at nadir)	105	105	105	105
Noise equivalent temperature difference (NEΔT) (K)	0.3	0.3	0.3	0.3
Dynamic range (K)	0–350	0–350	0–350	0–350
Scan width from nadir (degrees)	±47.4	±47.4	±47.4	±47.4
Antenna beamwidth (degree)	7.5	7.5	7.5	7.5
Antenna beam efficiency (%)	>90	>90	>90	>90
Optics – Two scanning reflector antennas Scanner – 9.5-degree stepper through 360-degree scan Data output – 12-bit binary at a 0.32-kbps rate				

the spacecraft for later transmittal to the CDA stations in Alaska and Virginia, will provide full global coverage. Because of the low power (75-mW peak), frequency instability, and various modulation schemes used, the existing 121.5- and 243-MHz ELT/EPIRB's provided locations to an accuracy of 10 to 20 km. The new 406-MHz system will provide a location accuracy of 2 to 5 km and will also provide user classification and identification, allow for a global coverage capability by providing spaceborne processing and storage, and permit user growth by providing the capability for 90 (minimum) to 200 (design goal) simultaneous distress incidents within the satellite antenna field of view.

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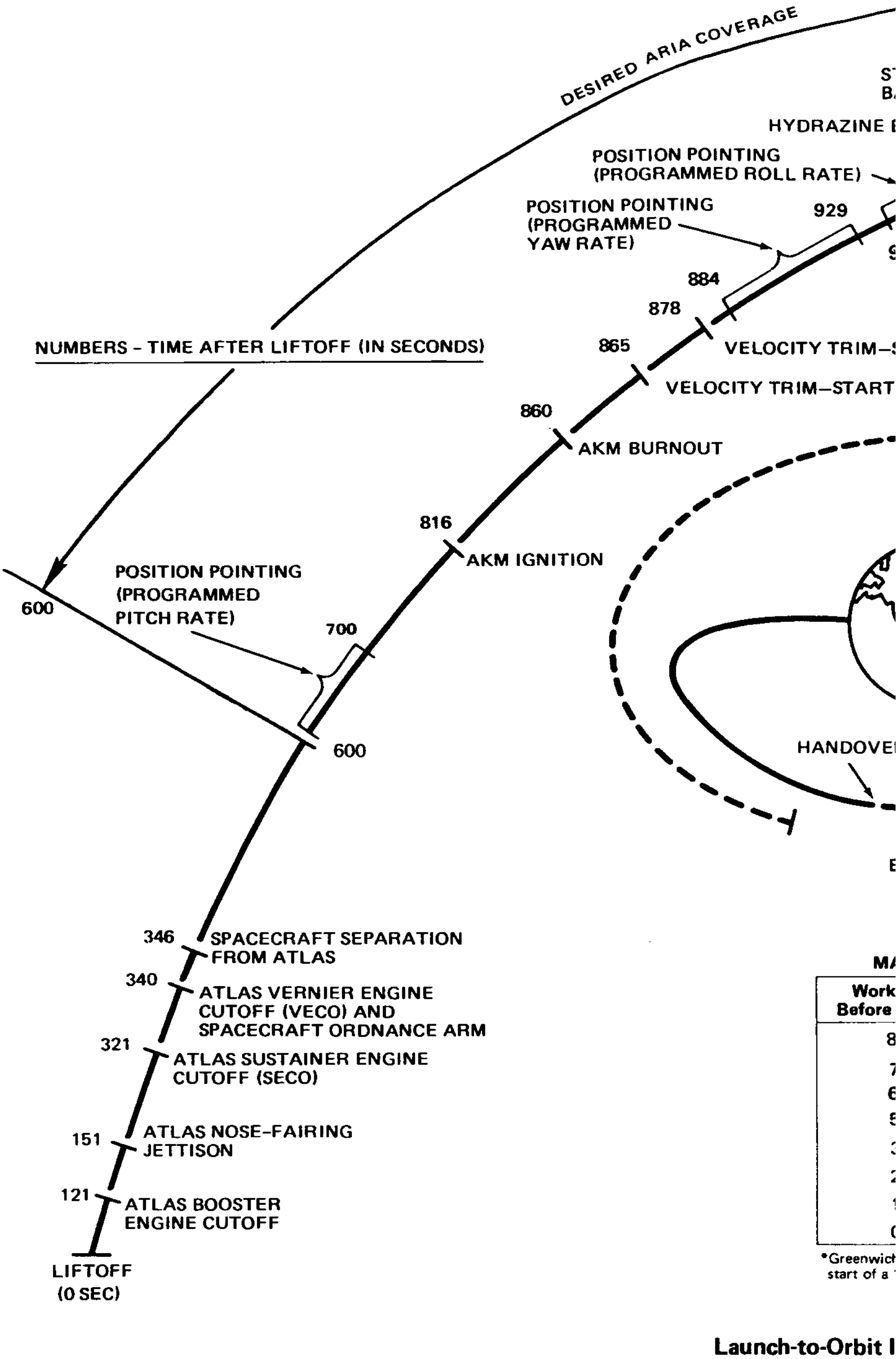
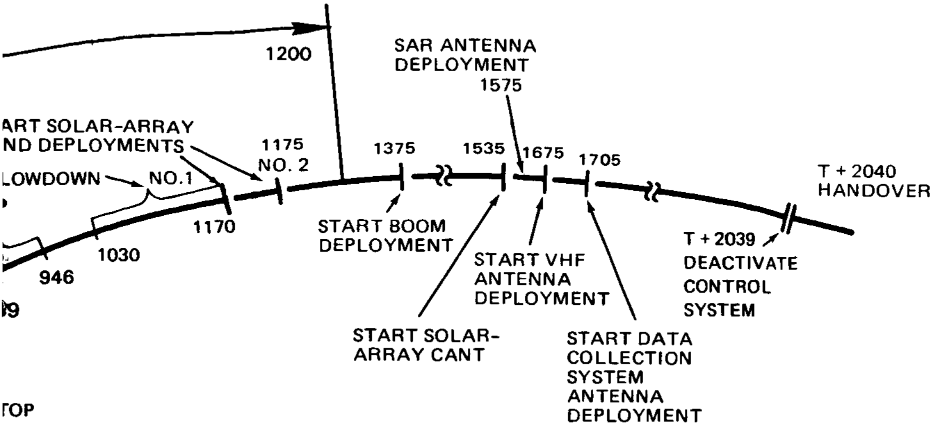
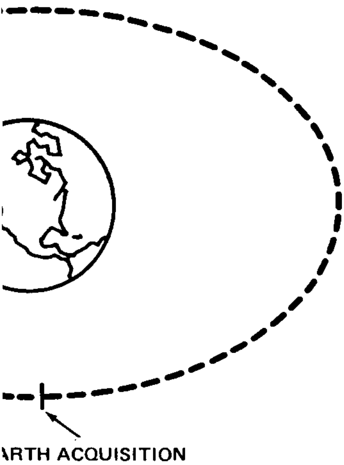


Launch-to-Orbit I





NOAA-G
MAJOR LAUNCH EVENTS

Event	Time from Liftoff (seconds)
Liftoff (L/O)	T +0 at ≃15:52 GMT
Booster engine cutoff (BECO)	121.5
Booster package jettison (BPJ)	124.6
Nose fairing jettison (NFJ)	151.5
Sustainer engine cutoff (SECO)	320.9
Vernier engine cutoff (VECO)	339.9
Spacecraft separation	345.9
Pitch rate—start	600.0
Pitch rate—stop	700.0
Solid motor—ignition	816.4
Solid motor—burnout	860.0
Velocity trim—start	865.0
Velocity trim—stop	878.5
Hydrazine isolation	879.1
Yaw rate—start	884.0
Yaw rate—stop	929.0
Roll rate—start	939.0
Roll rate—to orbit rate	946.0
Hydrazine blowdown—start	1030.0
Hydrazine blowdown—stop	1170.0
Array deployment	1170.0
Boom deployment	1375.0
Array cant	1535.0
SAR ant. deployment	1575.0
VRA deployment	1675.0
UDA deployment	1705.0
Handover	2040.0

NOAA-G
IOR PRELAUNCH EVENTS

Days aunch	Event
	Mate of launch vehicle
	Spacecraft aliveness test
	Spacecraft readiness test
	Spacecraft readiness test
	Fairing squib verification
	Booster fuel load
	Countdown begins
	Launch at ≃15:52 GMT*

Mean Time—This is the
-minute window.

jection Sequence

EARTH RADIATION BUDGET EXPERIMENT (ERBE)

The ERBE instruments, provided by TRW, consist of a medium and wide field-of-view non-scanning radiometer and a narrow field-of-view scanning radiometer. The instruments are to be flown on NOAA-F and -G and augmented by a third spacecraft, the ERBS. The objectives of this experiment are:

- To measure Earth radiation energy budget components at satellite altitude with a resolution corresponding to 200 to 250 km at the Earth's surface several times per day

- To make measurements from which monthly average Earth radiation energy budget components can be derived at the top of the atmosphere on regional, zonal, and global scales

- To provide an experimental prototype for an operational ERBE instrument for future long-range (decade or longer) monitoring programs

ARGOS/DATA COLLECTION SYSTEM (DCS)

The ARGOS/DCS, provided by France, assists NOAA in its overall environmental mission and in the support of the Global Atmospheric Research Program. Approximately 2000 platforms (buoys, free-floating balloons, and remote weather stations) measure temperature, pressure, and altitude, and transmit these data to the satellite. The onboard DCS receives the incoming signal, measures both the frequency and relative time of occurrence of each transmission, and retransmits these data to the central processing facility. The DCS information is decommutated and sent to the Centre National d'Etudes Spatiales ARGOS processing center where it is processed, distributed, and stored on magnetic tape for archival purposes.

Characteristics of the DCS are:

- System Specifications

  Elevation angle of visibility . . . . 5°

  Number of platforms requiring location/
  velocity and four sensor channels, visible
  in a 5-degree visibility circle. 120

  Total number of such platforms over
  the globe 2000

Percentage of platforms with six good Doppler measurements per day	>85 percent
Expected location accuracy	5- to 8-km rms
Expected velocity accuracy	1 to 1.6 mps

- Platform

Frequency	401.65 MHz
Oscillator stability drift (15 min)	0.5×10^{-9}/min
Jitter	2×10^{-9}
Power emitted	3 W
Message	
Coding: biphase, 1.1 ±0.1 rad	400 bps
Phase deviation, duration for a standard platform	360 ms

- Satellite

Receiver	
Noise factor	3 dB
Doppler shift, drift, and oscillator tolerance	24 kHz
Search unit	
Number of zones analyzed	4 of 6 kHz each
Analysis filter bandwidth	300 Hz (20 steps)
Data recovery units	
Number	4
Carrier phase loop tracking bandwidth	40 Hz
Doppler counting duration	120 ms

Interface to satellite telemetry system

Table 5
Communications Data Handling

Link	Carrier Frequency	Information Signal	Baseband Bit Rate	Modulation	Subcarrier Frequency
Command*	148.56 MHz	Digital commands	1 kbps	Ternary frequency-shift keyed (FSK)/AM	8, 10, and 12kHz
Beacon	137.77 and 136.77 MHz	HIRS, SSU, MSU, SEM, DCS data, spacecraft attitude data, time code, housekeeping telemetry, memory verification; all from TIP	8320 bps	Split-phase phase-shift keyed PSK	
VHF real time	137.50 and 137.62 MHz	Medium-resolution video data from AVHRR	2 kHz	AM/FM	2.4 kHz
S-band real time	1698 or 1707 MHz	High-resolution AVHRR and TIP data	665.4 kbps	Split-phase PSK	
S-band playback	1698, 1702.5, or 1707 MHz	High-resolution AVHRR data from MIRP, medium-resolution AVHRR data from MIRP; all TIP outputs	2.6616 Mbps	Randomized non-return-to-zero/PSK	
Data collection (uplink)	401.64 MHz	Earth-based platforms and balloons	400 bps	Split-phase PSK	
S-band playback to European ground station	1698, 1702.5, or 1707 MHz	TIP data recovered from tape recorders	332.7 kbps	Split-phase PSK	

*Uplink to the satellite

Table 5 (Continued)
Communications Data Handling

Link	Carrier Frequency	Information Signal	Baseband Bit Rate	Modulation	Subcarrier Frequency
SAR L-band Downlink	1544.5 MHz	Data transmission from SARR and SARP to ground LUT's	300 kHz (video)	PM 2 rad peak	
SAR Uplinks	SARR 121.5 MHz 243 MHz 406.05 MHz SARP 406.025 MHz	From ground ELT/EPIRB's to spacecraft	(video) 25 kHz for 121.5 MHz 45 kHz for 243 MHz 400 bits/sec for 406 MHz	AM for 121.5/243 MHz PM for 406 MHz	
Periodically interrogated buffer, average-bit rate . . . . 720 bps					

COMMUNICATIONS AND DATA HANDLING

The communications subsystem uses nine separate transmission links to handle communications between the satellite and the ground stations. Table 5 summarizes the communications links.

Communications and data handling characteristics are:

- TIROS Information Processor (TIP)
  - Flexible low-rate data formatter and telemetry processor
  - Boost, orbit, and dwell modes
  - 8320 bps (orbit)
  - 16,640 bps (boost)
- Manipulated Information Rate Processor (MIRP)
  - High-rate data formatter and processor

– Performs multiplexing, formatting, resolution reduction, and geometric correction functions

– Analog Automatic Picture Transmission (APT): Global Area Coverage (GAC) data (66.54 kbps); high-resolution picture transmission (HRPT) data (665.4 kbps); Local Area Coverage (LAC) data (665.4 kbps) outputs

- Digital Tape Recorder (DTR)

  – Five digital data recorders

HIGH-RESOLUTION RADIOMETRY

One of the objectives is to provide timely day and night sea-surface temperature and ice, snow, and cloud information to diverse classes of users. The AVHRR is used to obtain these data. Requirements include:

- Worldwide direct readout to ground station of the APT class, at low resolution (4 km)
- Worldwide direct readout to ground stations of the HRPT class (1-km resolution)
- Global area coverage (GAC) of onboard data at relatively low resolutions (4 km) for central processing
- Local area coverage (LAC) of onboard storage of data from selected portions of each orbit at high resolution (1 km) for central processing

DATA TRANSMISSION

The sounder system data along with radiometry data will be telemetered through the TIROS Information Processor (TIP) telemetry system on NOAA-F. Data will be transmitted full resolution in the following modes:

- Worldwide direct TIP transmission - beacon link
- Worldwide direct TIP multiplexed with HRPT
- TIP multiplexed with low resolution AVHRR data stored and played back (GAC)

- TIP multiplexed with full resolution AVHRR data stored and played back (LAC)

- TIP-only data stored and played back during blind orbits

COMMAND

The CDA stations control the operation of the satellite by programmed commands transmitted to the satellite on a 148-MHz radio signal.

- Command-link bit rate: 1000 bits per second

- Stored commands

  - Table capacity: 129 commands at launch and on orbit until Stored Command Table (SCT) Extension

  - Table capacity: 2300 commands on orbit after SCT Extension (launch plus 2 days)

  - Time tag: 1.0-second granularity, 36-hour clock

GROUND SYSTEM

A principal operating feature of the TIROS-N system is the centralized remote control of the satellite, through the CDA stations, by the NOAA National Environmental

Satellite Data Information Services (NESDIS) Satellite Operation Control Center (SOCC). The ground system is made up of the Data Acquisition and Control Subsystem (DACS) and the central processing system designated the Data Processing Services Subsystem (DPSS).

NESDIS SOCC

The central operations and control center for satellite operations is located at Suitland, Maryland. SOCC is responsible for operational control of the entire ground system. Specifically, SOCC is responsible for the following.

CDA Stations

The primary command and data acquisition stations are GFOM, located at Fairbanks, Alaska, and WOMS, located at Wallops Station, Virginia. Through a cooperative agreement between NOAA/NESDIS and the Etablissement d'Etudes et de Recherches Meteorologiques (EERM) in France, stored and real-time TIP data can be relayed from the Lannion Centre de Meteorologie Spatiale (CMS) via the GOES satellite.

The CDA stations transmit command programs to the satellite, acquire and record meteorological and engineering data from the satellite. All data are transmitted between CDA and Suitland via commercial communications links. Commands are transmitted between SOCC and CDA via commercial communications links.

Ground Communications

The ground communications links for satellite operations are provided by Satcom and Nascom. Nascom provides any launch-unique communications links for satellite launch. This support is defined in the Network Operations Support Plan (NOSP) and the NASA Support Plan (NSP). Satcom provides all voice and data links between the SOCC and the CDA stations after launch. Satcom is provided and operated by NESDIS.

NESDIS Data Processing Services Subsystem (DPSS)

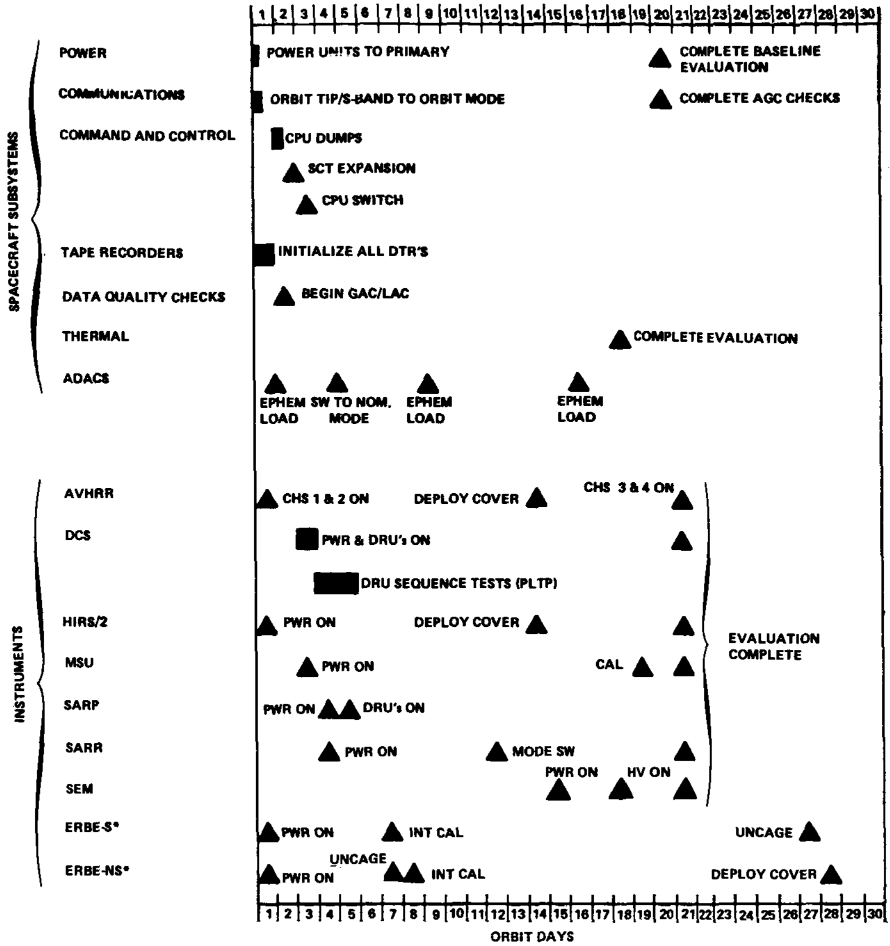
DPSS acquires data from the CDA stations via SOCC and is responsible for the data processing and generation of meteorological products on a timely basis to meet the TIROS program requirements. NOAA provides all hardware and software for DPSS. NOAA will provide ephemeris data and strip out SAR data from MIRP/GAC data dumps and transmit to U.S. and Canadian SAR Mission Control Centers. In addition, NOAA will strip out SEM and ERBE data and transmit these data to NOAA-SEL and Langley Research Center, respectively for processing.

GSFC Facility Support

Office of Space Tracking and Data Systems (OSTDS) associated support is requested through the Support Instrumentation Requirements Document (SIRD), with other support as described in Memoranda of Understanding.

During launch and early orbit (approximately 24 hours), special Spacecraft Tracking and Data Network (STDN) support for telemetry reception and contingency commanding is required as described in the SIRD. There is a requirement for STDN to provide emergency support for TIROS spacecraft if requested during their operational lifetime, provided STDN VHF capability exists.

The North American Air Defense Command (NORAD) has prime responsibility for orbit determination, which includes establishing the initial orbit solution and providing updated orbital parameters on a routine basis throughout the life of the mission. NORAD provides the orbital information through the NASA/GSFC communications to NOAA/SOCC. NASA/GSFC will provide nominal prelaunch orbital and prediction information, special support for initial orbit estimation, and initial quality-control checks of the NORAD orbital data. All attitude determination is to be accomplished by the NOAA central data processing facility.



*Completion of ERBE: Begin daily CAL's, Day 36; scanner cover deploy, Day 41; begin routine Ops, Day 60.

NOAA-G Activation and Evaluation Timeline